

Stage Discharge Relationships along the River

Expectation:	Stage-discharge relationships and associated over bank flow and floodplain inundation relationships that are similar to pre-channelization conditions.
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Relevant Endpoints:	Sociopolitical - Navigation Restoration - Physical Integrity - Hydrology Restoration - System Functional Integrity - Habitat Quality Restoration - System Functional Integrity - River/Floodplain Interactions
Baseline Conditions:	<p>Baseline conditions were derived from: 1) daily discharge at S65 (June 1971 - May 1999); 2) daily stage at Fort Kissimmee in Pool B (October 1984 - May 1999); 3) daily headwater and tailwater stage at S65C; 4) daily stage at C38BAS in Pool D; and 5) daily stage at PC33 on Micco Bluff Run in Pool C. S65 is located at the outlet of the Upper Kissimmee Basin and contributes approximately 60% of flows to the Kissimmee River. S65C is located near the middle of the area to be restored and is the downstream control for the first phase of restoration. Data at PC33 are representative of existing conditions (November 1997 through May 1999) within the area that will be affected by the first Phase of restoration. Data at C38BAS are representative of existing conditions (October 1997 through May 1999) within the area that will be affected by the third Phase of restoration. Headwater (Pool C) and tailwater (Pool D) levels at S65C are representative of existing water levels throughout Pool C and D (June 1971 - May 1999) and were included due to the limited amount of data at PC33 and BASC38.</p> <p>The natural sloping water surface of the historic river has been replaced by a series of five Pools (A, B, C, D and E) in which stage is stepped down in six feet increments from Lake Kissimmee to Lake Okeechobee. Water levels are controlled by the downstream water control structure, which is operated to maintain a design surface water elevation in each Pool. Baseline data for Pools C and D (Figure 1) shows stage does not vary significantly with headwater discharge. Flows are contained within the banks of C38, which has drained the northern portion of each pool and permanently inundated the floodplain at the lower portion of each pool (Toth, 1993).</p> <p>Since 1984, water levels at Fort Kissimmee and throughout Pool B have been influenced by seasonal stage fluctuations and Demonstration Project weirs. Baseline data for Fort Kissimmee (Figure 1) shows stage increases from 38 to 46 feet with increasing headwater inflows, which has temporarily flooded 15 - 100 percent of the adjacent floodplain.</p>
Reference Conditions:	<p>Reference conditions were derived from: 1) daily discharge (February 1934 - June 1959) at the outlet of Lake Kissimmee (near existing location of S65); 2) daily stage (April 1942 - June 1959) at Fort Kissimmee (Pool B); 3) daily stage (February 1934 - June 1959) at Fort Bassinger (Pool D); and 4) estimated daily stage (April 1942 - June 1959) at PC33. Stage at PC33 was estimated by linear interpolation using Fort Kissimmee and Fort Bassinger data and is representative of reference conditions for the lower portions of Pool C.</p>

Pre-channelization stage-discharge relationships along the Kissimmee River (Figure 2) are representative of a typical river system where stage increases with discharge until over bank

flow occurs. Historic data indicate that over bank flow occurred when discharges exceeded (1400-2000 cfs). However, the onset of over bank flow varied with channel morphology along the river. Headwater discharge is a better predictor of Fort Kissimmee stage ($R^2 = 0.90$) than PC33 stage ($R^2=0.86$) and Fort Bassinger stage ($R^2=0.82$), due to the longitudinal location of these gauges along the river and the associated cumulative influence of tributary inflows.

Historic relationships between stage and discharge (Figure 2) indicate that headwater discharge of 1400 cfs resulted in stages at Fort Bassinger ranging from 29 - 32 feet, which inundated 36 to 95 percent of the floodplain at this location. The regression between headwater discharge and stage at Fort Bassinger (Figure 2) predicts a stage of 30.9 feet with headwater discharge of 1400 cfs, which would inundate approximately 85% of the adjacent floodplain.

When historic headwater discharges were 1400 cfs, stage at Fort Kissimmee ranged from 44 to 47 feet, which would inundate 93 to 100 percent of the floodplain. The predicted (by the regression equation) stage at Fort Kissimmee with headwater discharge of 1400 cfs is 45.3 feet, which would inundate approximately 100% of the adjacent floodplain.

Historic stages in Pool C, near PC33, were estimated to range between 34 - 37 feet when headwater discharges were 1400 cfs, which would inundate 43 to 97 percent of the floodplain. The estimated stage at PC33 that is predicted by the regression equation and a headwater discharge of 1400 cfs is 35.6 feet, which would inundate approximately 91% of the adjacent floodplain.

Mechanism for

Achieving Expectation:

A new regulation schedule and operational rules will provide headwater inflows that reflect climatic inputs to the upper basin and a more natural flow regime to the Kissimmee River. In addition, regulation schedules and operation rules for the S65D and S65C structures will be modified to replicate historic stage discharge relationships at these locations.

Restoration of the physical form of the river, through backfilling C38 and carving new river segments, will direct flows through the Kissimmee River. This will lead to reestablishment of a sloping water surface gradient, resulting in over bank flow along most reaches of the restored river when flows exceed 1400 to 2000 cfs.

Adjustments for

External Constraints:

None

Means of Evaluation:

Reestablishment of historic stage-discharge relationships will be evaluated by comparing post restoration data to historic values. Continuous stage will be collected at four river locations in Pool C (PC11, PC33, PC43, and PC54). Scatter plots will be used to evaluate if the stage-discharge relationships replicate historic patterns. Evaluations will begin with the first year of data after implementation of the new S65 regulation schedule. Headwater discharges of 1400 cfs should result in stages in Pool C that result in floodplain inundation characteristics similar to historic conditions. Analyses will continue until the post-restoration data set includes the full range of expected flow conditions at S65 (0 - 11,000 cfs).

Physical restoration near Fort Bassinger and Fort Kissimmee are part of the third and fourth phases of the restoration project. Evaluation at these sites will begin after one year of post-

restoration data is collected.

Time Course: Historic stage-discharge relationships will be initiated with the implementation of the new regulation schedule, backfilling of C-38, and recarving of new river sections.

References

Toth, L.A. 1993. The ecological basis of the Kissimmee River restoration plan. *Florida Scientist* 56:1, 25-51

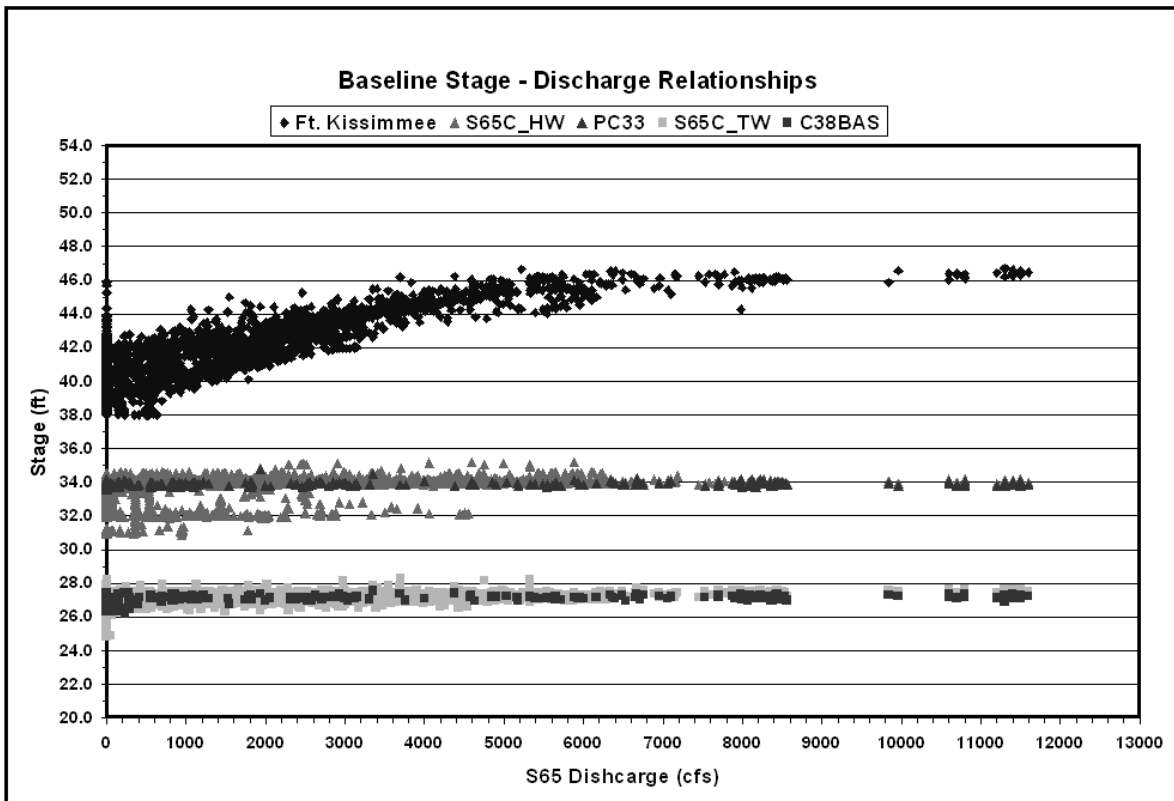


Figure 1. Relationships between headwater discharge and stages along the channelized Kissimmee River.

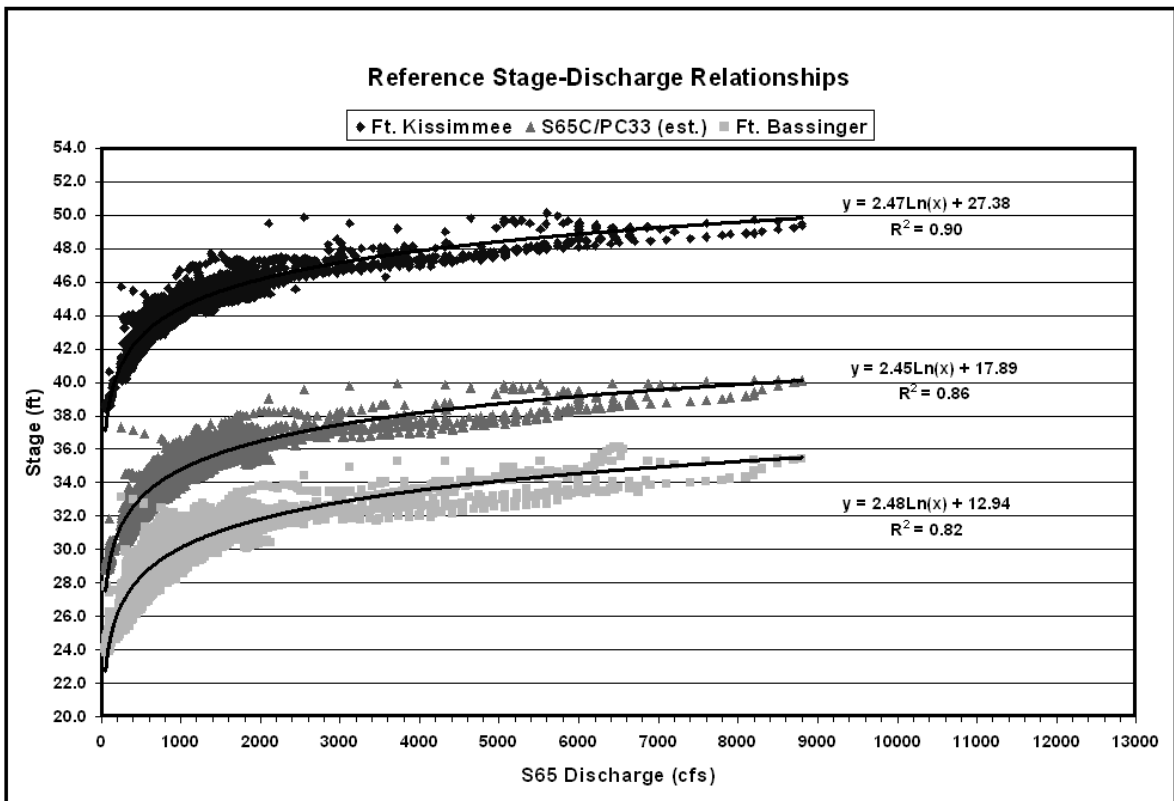


Figure 2. Relationships between headwater discharge and stages along the pre-channelized Kissimmee River.